



THE ROCAS ATOLL, BRAZIL: A PRELIMINARY SURVEY OF THE CRUSTACEA AND POLYCHAETE FAUNA ¹

(With 4 figures)

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ABSTRACT: Among the oceanic islands in the Brazilian coast, Rocas Atoll is special since it is the only atoll in the Southern Atlantic and is the first Marine Biological Reserve of the Brazilian Coast. The atoll elliptical ring (3.7 to 2.5km) has a shallow central lagoon surrounded by a large reef plateau flat composed mainly of coralline algae. Despite its ecological importance the crustacean and polychaete fauna of Rocas Atoll is still poorly known with only 34 and 17 species, respectively, recorded. For this reason, an integrate effort with the aim of assessing the marine biodiversity of this Atoll was developed, through samples of reef and sedimentary environments. Results of this effort are here presented.

Key words: Rocas Atoll. Crustacea. Polychaeta. Oceanic Islands. Brazil.

RESUMO: O Atol das Rocas, Brasil: análise preliminar da fauna de crustáceos e poliquetas.

Entre as ilhas oceânicas da costa brasileira, o Atol das Rocas se destaca por ser o único atol do Atlântico Sul e a primeira Reserva Biológica Marinha da costa brasileira. O anel elíptico do atol (3,7 a 2,5km) apresenta uma laguna central circundada por um grande platô recifal composto principalmente de algas calcárias. Apesar de sua importância ecológica, a fauna de crustáceos e poliquetas do Atol das Rocas ainda é pouco conhecida, com apenas 34 e 17 espécies, respectivamente, registradas. Por essa razão, foi realizado um esforço integrado com o objetivo de avaliar a biodiversidade marinha deste Atol através de coletas em ambientes recifais e sedimentares. Os resultados deste esforço são aqui apresentados.

Palavras-chave: Atol das Rocas. Crustacea. Polychaeta. Ilhas Oceânicas. Brasil.

INTRODUCTION

Oceanic islands are remarkable environments owing to their high diversification (MARGALEF, 1980) usually having a higher endemism when compared with nearby environments. Such endemism is more pronounced in nearshore areas since these islands are geographically isolated from the adjacent continental shelves. Variations in the degree of endemism are a function of life history strategies, mainly the duration of the larval phase and dispersion capacity (SCHELTEMA, 1992). In this way, several polychaete species with short-phase larvae and brooding crustaceans, mainly peracaridans (*e.g.* amphipods, isopods, tanaidaceans, and cumaceans) from shallow water are more likely to present a high degree of insular endemism. Furthermore, oceanic islands presents lower levels of species richness owing to their geographic

isolation and the restricted area of their near shore zones, as predicted by the theory of island biogeography (MCARTHUR & WILSON, 1967). Nevertheless, some tropical oceanic islands have a high cover of reefs in their subtidal and intertidal habitats, an environment that can hold a great diversity of associated fauna, mainly cryptic organisms (BOUCHET *et al.*, 2002). Furthermore, oceanic islands environments, especially those from tropical regions, are much vulnerable to human impacts owing to their low resilience capacity (CHOWN *et al.*, 1998). Besides, such environments are many times subjected to predatory tourism and others economical-industrial activities.

The composition of the Brazilian marine benthic fauna, mainly regarding the northern and eastern coast, is still poorly known. Moreover, records are restricted to surveys conducted in the intertidal zone, inner continental shelf and some coastal

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islands (LANA, *et al.* 1996). Hence, owing to the restricted knowledge, nothing can be said about previous environmental impacts in Brazilian oceanic islands and, for future assessments, more studies of their fauna are required.

Among the Brazilian oceanic islands, *i.e.*, Fernando de Noronha, Trindade, Rocas Atoll, and São Pedro & São Paulo Archipelago, Rocas Atoll has a special interest since it is the only atoll in the Southwestern Atlantic and was the first Marine Biological Reserve in the Brazilian Coast. Nowadays, besides scientific research, no activities are allowed in the Atoll.

STUDY AREA

The Rocas Atoll is located approximately 250km off the Brazilian northeastern coast between 03°45' and 03°56'S and 33°37' and 33°56' W and 145km west of Fernando de Noronha Archipelago. It is located at the top of a seamount which reaches a depth of ca. 25 meters from the surface, and belongs to the Fernando de Noronha Chain, part of the Fracture Zone of Fernando de Noronha.

The Atoll frame is composed mainly of coralline algae (over 60%), being mainly *Porolithon cf. pachydermum* (GHERARDI & BOSENCE, 2005), vermetid gastropods and hermatypic corals, the latter represented mainly by *Siderastrea stellata* (KIKUCHI, 1994), although with a relatively small contribution (less than 10% of the reef frame). GHERARDI & BOSENCE (1999) showed the contribution of several genera of encrusting coralline algae in the atoll construction and latter described the reef growth patterns during the late Holocene sea-level changes (GHERARDI & BOSENCE, 2005). Among the massive corals that contributed to the atoll formation, *Siderastrea stellata* strongly dominates, however, nowadays this species is restricted to wave protected areas. Present patterns of distribution of hermatypic corals and other cnidarians can be assessed in ECHEVERRÍA *et al.* (1997).

The Atoll elliptical ring has the largest diameter of 3.7km and the smallest about 2.5km, with a large and shallow inner lagoon and a large plateau or reef flat (Fig.1) surrounding it (KIKUCHI, 1994). Predominant winds and currents runs from east to west direction almost all the time, and in this way the atoll presents a constantly wave exposed side (east side) and a protected side (west side). On the west side there are two sandy islands (Cemitério Island and Farol Island; Figs.1-2). The distribution of cnidarian's species are clearly influenced by

these patterns probably due to sediment and detritus accumulation on the west side (ECHEVERRÍA *et al.*, 1997).

During the high tide, the entire Atoll is covered by the sea water except the two islands mentioned before. During the low tide, the reef top flat is uncovered, and several pools are exposed. These pools are constituted by depressions on the reef flat, and vary from few meters to more than 150m in length, varying from 0.5m to more than 7m in depth. Usually its bottoms are constituted by carbonatic sand. The lateral walls of these pools constitute an interesting habitat, and usually bear a relatively high diversity, including cnidarians (ECHEVERRÍA *et al.*, 1997), sponges (MORAES *et al.*, 2006), macroalgae (VILLAÇA *et al.*, 2006) and mollusks (GOMES *et al.*, 2006). Names and localization of these pools are presented in table 1.

Water temperature inside the atoll may increase up to 39°C during low tides and sunny days in small pools, and the median temperature outside of atoll is 27°C (25,5° to 28°C) (KIKUCHI & LEÃO, 1997). Precipitation is irregularly distributed along the year varying from 183mm to 2663mm per month (KIKUCHI, 2002), with no other source of fresh water in the whole Atoll. The Rocas Atoll region receives the South Equatorial current originated from west coasts of Africa with a velocity varying from 30cm/s to 60cm/s (RICHARDSON & MCKEE, 1984; SILVEIRA *et al.*, 1994). Tides are semi-diurnal reaching maximum amplitude in neap tides of 2.4m (KIKUCHI, 1994).

In order to assess the marine biodiversity fauna of the Brazilian oceanic islands, especially of Crustacea and Polychaeta, we developed the project 'Biodiversity of the Brazilian Oceanic Islands: Crustacea and Polychaeta.' This project was conducted with the financial and logistic support of the Federal University of Rio de Janeiro (UFRJ) and the Brazilian Environmental Agency (IBAMA) by means of the Biological Reserve of Rocas Atoll, which is coordinated by Maurizélia de Brito Silva.

Hence, for both taxonomic groups (Crustacea and Polychaeta), the present study will improve the number of species referred for the Rocas Atoll. Besides the new records, new taxa are likely to be discovered and a rise in the degree of endemism is also expected after these surveys.

Main goals of this project are:

(1) To provide a preliminary inventory of the crustacean and polychaete fauna of the Rocas Atoll.

(2) Assess the degree of endemism of these taxa for the Rocas Atoll and, secondarily, for the Brazilian oceanic islands.

(3) Provide detailed descriptions of crustaceans and polychaetes species, which will help on species identification for ecological and biological studies.

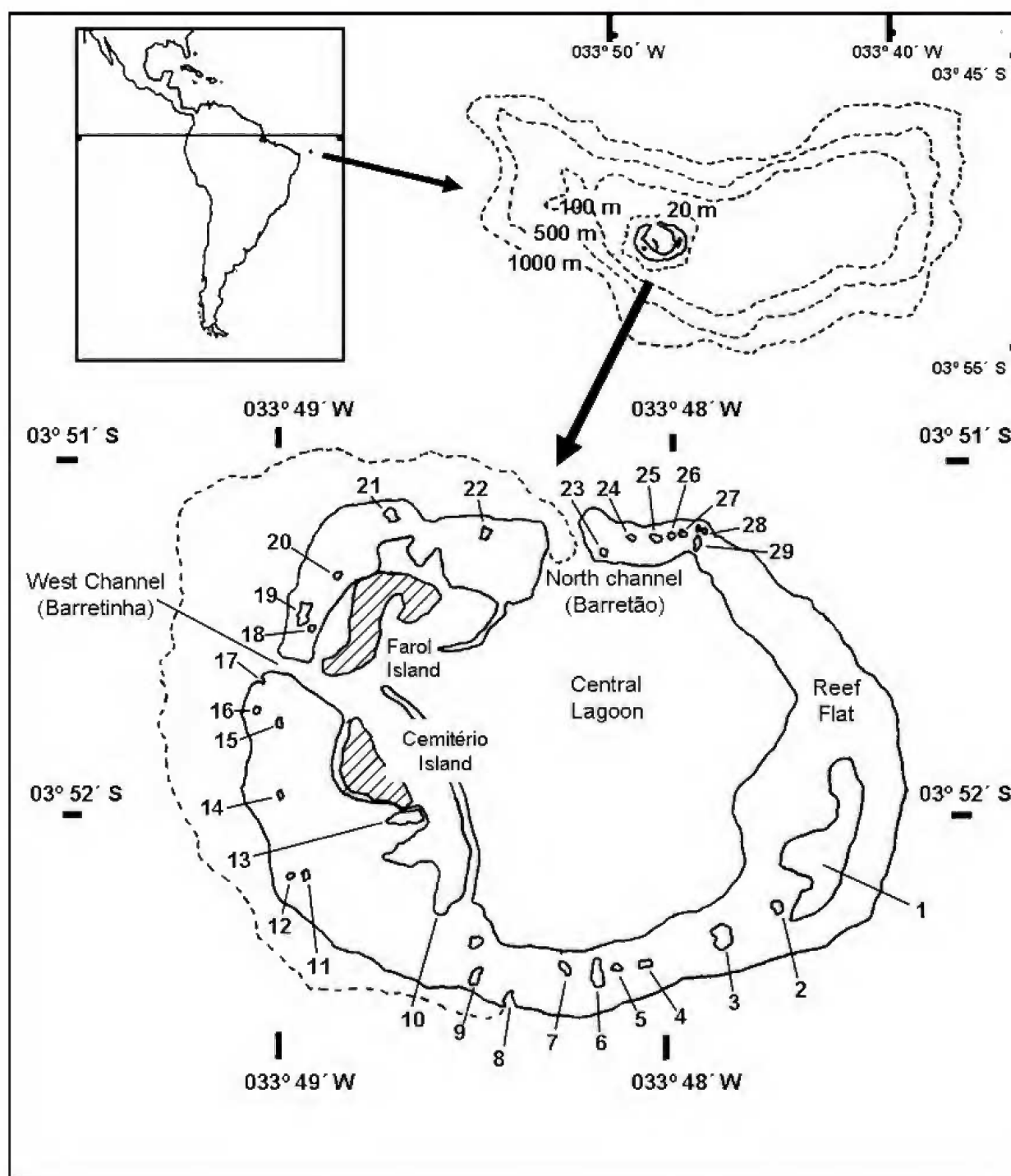


Fig.1- Map of the Rocas Atoll localized in the Southwestern Atlantic, showing general morphology of the reef, localization of the two islands, the central lagoon, channels and the principal pools over the reef flat. Number refers to the pools, where the geographic coordinates can be found in table 1 (redrawn from ECHEVERRIA *et al.*, 1997).



Fig.2- View of Farol Island from the Lighthouse.

MATERIAL AND METHODS

SURVEYS

Collections of crustaceans and polychaetes under the scope of the project were obtained in three expeditions to the Biological Reserve of Rocas Atoll with the duration of ca. 40 days each. Two or three persons were involved in collecting benthic samples of crustacean and polychaetes during field work. All expeditions occurred during the years of 2000 and 2001 in: (1) September/October 2000; (2) December, 2000 and January 2001, and (3) November/December 2001.

Expeditions to Rocas Atoll initiated with a 24 hours boat trip (260km) from Natal (Rio Grande do Norte State) to Rocas Atoll. The trip aboard of the 40 feet sailing boat 'Delícia' as well as lodging in Rocas Atoll (Fig.3) were both provided by IBAMA, responsible for the Marine Biological Reserve of Rocas Atoll.

SAMPLING

Samples were taken at three different environments as (1) main lagoon (0-2m depth), (2) tidal pools (0-7m depth), and (3) external sublittoral area (10-18m depth) (Fig.1). Localization and names of individual tidal pools are given in figure 1 and table 1. In each of these locations, both hard and soft-bottom were sampled. Biological substrates as algae and sponges (Fig.4) were sampled for assessing its associated fauna.

In coralline bottoms, two procedures were used: (1) directly removal of specimens after manual fragmentation of the coralline mass, or (2) extraction by suffocation after maintaining coralline fragments in closed dark buckets under sunlight for ca. 2 hours. Floating specimens were then removed using forceps and hand nets, being fixed in 10% formalin (polychaetes) or 70% alcohol (crustaceans) and further preserved in 70% alcohol (polychaetes and crustaceans).

TABLE 1. Geographic coordinates of the reef flat pools from Rocas Atoll cited in figure 1 (GPS measured).

POOL NUMBER	LAT. / LONG.	UNOFFICIAL NAME
01	03° 52,28' S / 033° 47,65' W	Piscina das Rocas
02	03° 52,28' S / 033° 47,68' W	-
03	03° 52,31' S / 033° 47,87' W	-
04	03° 52,42' S / 033° 48,06' W	-
05	03° 52,45' S / 033° 48,16' W	-
06	03° 52,43' S / 033° 48,24' W	Piscina das Âncoras (Anchors Pool)
07	03° 52,42' S / 033° 48,30' W	Piscina das Tartarugas (Turtles Pool)
08	03° 52,46' S / 033° 48,43' W	Salão
09	03° 52,46' S / 033° 48,55' W	-
10	03° 52,30' S / 033° 48,48' W	Piscina das Correntes
11	03° 52,18' S / 033° 49,08' W	-
12	03° 52,17' S / 033° 49,07' W	-
13	03° 51,96' S / 033° 49,14' W	-
14	03° 51,94' S / 033° 49,10' W	-
15	03° 51,74' S / 033° 49,09' W	-
16	03° 51,70' S / 033° 49,50' W	-
17	03° 51,61' S / 033° 49,14' W	Falsa Barreta Channel
18	03° 51,50' S / 033° 48,10' W	-
19	03° 51,39' S / 033° 48,40' W	-
20	03° 51,32' S / 033° 48,60' W	-
21	03° 51,17' S / 033° 48,75' W	-
22	03° 51,30' S / 033° 48,56' W	-
23	03° 51,25' S / 033° 48,19' W	-
24	03° 51,26' S / 033° 48,11' W	-
25	03° 51,29' S / 033° 48,01' W	-
26	03° 51,20' S / 033° 48,00' W	-
27	03° 51,19' S / 033° 47,96' W	-
28	03° 51,28' S / 033° 47,91' W	-
29	03° 51,18' S / 033° 47,92' W	-

Names included are not exhaustive.

Sediment samples were taken using cylindrical cores (diameter=100mm, 250mm depth, *ca.* 0.008m²). Core samples were taken manually (8 to 10 replicates) in tidal-pools and main lagoon or diver-operated in the outside part of the Atoll. Sediment was then submitted to an elutriation procedure in a 15 L bucket with the suspension being sieved in a 0.5mm mesh-size, fixed in 10% formalin and transferred posteriorly to 70% ethanol. All collected material where subsequently sent to specialists with a compromise of studying and publishing results in

a special volume dedicated exclusively to this project. All the Crustacea material is deposited at Museu Nacional/UFRJ and the Polychaeta material is deposited at the Instituto de Biologia/UFRJ.

RESULTS AND DISCUSSION

CRUSTACEA OF ROCAS ATOLL

All the records of crustaceans from Rocas Atoll are

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Fig.3- Lodging in Rocas Atoll; fig.4- Paulo Secchin Young with a collected sponge of the genus *Ircinia*.

from scattered samples at the region without any general sampling program. Most of the records are from common large-bodied decapods that are found mostly on intertidal areas found in the surveys of COELHO (1965, 1967), COELHO & RAMOS (1972), COELHO & KOENING (1972), and FAUSTO-FILHO (1980). Besides decapods, only two amphipods (KRAPP-SCHICKEL &

RUFFO, 2000; SEREJO, 2004), and one cirriped were recorded (YOUNG, 1998). Up to this survey, a total of 34 crustacean species were recorded to the whole Rocas Atoll (Tab.2). Since there is a clear bias toward intertidal large-bodied decapods it is likely that this number is underestimated regarding the actual biodiversity of crustaceans from Rocas Atoll. This

underestimation was circumvented through a specific program for collecting also small-bodied crustaceans in subtidal and cryptic intertidal environments for both soft and coralline bottoms. Results from this survey increased the number of referred crustaceans

species to 55 (Tab.2), an increment of 62%. It must be stated that such increment did not represent all collected crustaceans in this survey since some speciose groups, such as Alpheidae and Brachyura (except Majiidae), were not still studied.

TABLE 2. Crustacean species recorded for the Rocas Atoll according to COELHO (1965, 1967) COELHO & RAMOS (1972), COELHO & KOENING (1972), FAUSTO FILHO (1980), YOUNG (1998), KRAPP-SCHICKEL & RUFFO (2000), SEREJO (2004), SENNA & SEREJO (2005, 2007), and this survey. Species in bold are those referred for the first time to Rocas Atoll.

TAXA	
Class Maxillopoda	Calcinus tibicen (Herbst, 1791)
Infraclass Cirripedia	Paguristes tortugae Schmitt, 1933
Superorder Thoracica	Family Porcellanidae
Order Sessilia	Pachycheles riisei (Stimpson, 1858)
Family Poecilasmatidae	Infraorder Brachyura
<i>Ceratoconcha floridana</i> (Pilsbry, 1931)	Family Majidae
Family Lepadidae	<i>Aepinus septemspinus</i> (A. Milne-Edwards, 1879)
Lepas anatifera Linnaeus, 1758	Chorinus heros (Herbst, 1790)
Family Pyrgomatidae	Macrocoeloma concavum Miers, 1886
Octolamis lowei (Darwin, 1852)	Microphtys bicornutus (Latreille, 1825)
Superorder Hoplocarida	<i>Mithraculus forceps</i> (A. Milne-Edwards, 1875)
Order Stomatopoda	<i>Mithrax hemphilli</i> Rathbun, 1892
Family Gonodactylidae	<i>Mithrax verrucosus</i> H. Milne-Edwards, 1832
<i>Gonodactylus austrinus</i> Manning, 1969	Nemausa acuticornis (Stimpson, 1871)
<i>Gonodactylus oerstedii</i> Hansen, 1895	Pitho lherminieri (Schramm, 1867)
<i>Gonodactylus spinulosus</i> Schmitt, 1924	<i>Podochele brasiliensis</i> Coelho, 1972
Family Pseudosquillidae	Family Xanthidae
<i>Pseudosquilla ciliata</i> (Fabricius, 1787)	<i>Actaea acantha</i> (A. Milne-Edwards, 1834)
Superorder Eucarida	<i>Banareia palmeri</i> (Rathbun, 1894)
Order Decapoda	<i>Cataleptodius floridanus</i> (Gibbes, 1850)
Infraorder Caridea	Family Grapsidae
Family Alpheidae	<i>Grapsus grapsus</i> (Linnaeus, 1758)
<i>Alpheus amblyonyx</i> Chace, 1972	<i>Plagusia depressa</i> (Fabricius, 1775)
<i>Alpheus bowieri</i> A. Milne Edwards, 1878	Family Gecarcinidae
<i>Alpheus cristulifrons</i> Rathbun, 1900	<i>Gecarcinus lagostoma</i> H. Milne-Edwards, 1835
<i>Alpheus floridanus</i> Kingsley, 1878	Family Cryptochiridae
<i>Alpheus normanni</i> Kingsley, 1878	<i>Troglocarcinus corallicola</i> Verrill, 1908
<i>Synalpheus sanctithomae</i> Coutière, 1909	Family Calappidae
<i>Synalpheus townsendi</i> Coutière, 1909	<i>Calappa gallus</i> (Herbst 1803)
Family Palaemonidae	Superorder Peracarida
Periclimenaeus caraibicus Holthuis, 1951	Order Amphipoda
Brachycarpus biunguiculatus (Lucas, 1846)	Family Melitidae
Leander tenuicornis (Say, 1818)	<i>Quadrimeaera cristianae</i> Krapp-Schickel & Ruffo, 2000
Family Processidae	Quadrimeaera chaelata Senna & Serejo, 2007
<i>Processa brasiliensis</i> Christoffersen, 1979	Quadrimeaera rocasensis Senna & Serejo, 2007
<i>Processa fimbriata</i> Manning & Chace, 1971	Family Talitridae
Family Disciadidae	<i>Talorchestia tucurauna</i> (Müller, 1864)
Discias serratirostris Lebour, 1949	Family Ingolfiellidae
Family Rhynchocinetidae	Ingolfiella rocaensis Senna & Serejo, 2005
Cinetorhynchus rigens (Gordon, 1936)	Superorder Peracarida
Infraorder Palinura	Order Isopoda
Family Palinuridae	Family Olibrinidae
<i>Panulirus echinatus</i> Smith, 1869	Olibrinus antennatus (Budde-Lund, 1902)
Infraorder Anomura	Family Philosciidae
Family Galatheidae	<i>Littorophiloscia culebrae</i> (Moore, 1901)
<i>Munida spinifrons</i> Henderson, 1885	Family Platyarthridae
Family Diogenidae	Niambia squamata (Budde-Lund, 1885)
<i>Dardanus venosus</i> H. Milne-Edwards, 1848	Family Porcellionidae
<i>Clibanarius antillensis</i> Stimpson, 1859	Porcellionides pruinosus (Brandt, 1833)
<i>Clibanarius tricolor</i> (Gibbes, 1850)	

POLYCHAETA OF ROCAS ATOLL

Polychaetes from Rocas Atoll were also referred from scattered samples from large oceanographic expeditions that sampled mainly off Rocas Atoll, such as the Calypso Expedition of 1966 (RULLIER & AMOUREUX, 1979). More recently, some surveys conducted specifically on the Biological Reserve also recorded some polychaetes species (*e.g.*, NETTO *et al.* 1999; NEVES & OMENA, 2003). Despite the ecological approach of the majority of these studies, new records were given for both the Rocas Atoll, Brazilian oceanic islands or even for the whole Brazilian coast. New species and detailed descriptions were also provided for specific taxa from Rocas Atoll (SANTOS & LANA, 2001, 2003). Even though NETTO *et al.* (1999) recognized 38 species

of 22 families for the whole Atoll, only five were nominated in the paper. Thus, besides all above effort, up to now only 17 species of polychaetes were recorded to the Rocas Atoll (Tab.3). This number is far from what should be expected for an environment composed of both reef and sedimentary habitats, which is likely to support a much higher diversity of polychaete species (PAIVA, 2005). This survey increased the number of referred species to 26, an increment of 53%. Only three families of polychaetes were still studied from the collection of this survey, a taxonomic effort that represents only 13% of the families already recorded by NETTO *et al.* (1999) for the whole Atoll. Thus an exponential increase in the number of polychaetes referred to the whole Atoll is expected after studying all collected families.

TABLE 3. Polychaete species recorded for the Rocas Atoll according to NETTO *et al.* (1999), NEVES & OMENA (2003), RULLIER & AMOUREUX (1979), SANTOS & LANA (2001, 2003), and this survey.

TAXA	
Class Polychaeta	<i>Nereis panamensis</i> Fauchald, 1977
Subclass Palpata	<i>Nereis trifasciata</i> (Grube, 1878)
Order Aciculata	<i>Nereis</i> sp.
Suborder Amphinomida	<i>Perinereis floridana</i> Ehlers, 1868
Family Amphinomidae	<i>Platynereis magalhaensis</i> Kinberg, 1866
<i>Eurythoe complanata</i> (Pallas, 1766)	Order Canalipalpata
<i>Hermodice carunculata</i> (Pallas, 1766)	Family Saccocirridae
<i>Linopherus cf. canairensis</i> (Langerhans, 1881)	<i>Saccocirrus papillocercus</i> Bobretzky, 1872
Suborder Phyllodocida	Suborder Spionida
Family Phyllodocidae	Family Spionidae
<i>Eteone heteropoda</i> Hartman, 1951	<i>Spio pettiboneae</i> Foster, 1971
Family Syllidae	Suborder Cirratulida
<i>Branchiosyllis oculata</i> (Ehlers, 1887)	Family Cirratulidae
<i>Haplosyllis spongicola</i> (Grube, 1855)	<i>Caulleriella cf. alata</i> (Southern, 1914)
<i>Pionosyllis gesae</i> Perkins 1981	Suborder Flabelligerida
<i>Syllis (Ehlersia) cornuta</i> Rathke, 1843	Family Acrocirridae
<i>Typosyllis variegata</i> (Grube, 1860)	<i>Macrochaeta clavicornis</i> (Sars, 1835)
Family Nereididae	Suborder Sabellida
<i>Ceratocephale rocaensis</i> Santos & Lana, 2001	Family Sabellidae
<i>Ceratonereis mirabilis</i> Kinberg, 1866	<i>Bispira melanostigma</i> (Schmarda, 1861)
<i>Ceratonereis cf. singularis</i> Treadwell, 1929	<i>Bispira</i> sp.
<i>Ceratonereis longicirrata</i> Perkins, 1980	<i>Notaulax occidentalis</i> (Baird, 1865)
<i>Neanthes acuminata</i> Ehlers, 1868	? <i>Hypsicomus elegans</i> (Webster, 1884)

Species in bold are those referred for the first time to Rocas Atoll.

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